

suffered to flow away. When the appearance of the metal informs the 'finer' that it has reached a certain stage of decarbonisation, he suffers it to escape into a broad shallow trough, exposing a large surface to the air, and he further aids the decarbonisation by the direction of a copious jet of water upon the fluid metal. Whatever the scientific results of this affusion may be, the apparent effect is a most active fume and splutter. Clouds of dense steam are thrown up, a horrible hissing is heard, and the stranger only stands still because he feels that in the mist he is just as likely to run into the furnace as to run away from it. This dreadful broil is by no means the least striking part of iron making. The loss during this process is about 10 per cent.

The iron, now called "finers' metal," has reached its first stage towards malleability, though apparently far less tractable than before. It has become highly infusible, hard, and brittle, even when hot. Its fracture is as white as silver, its lower surface dense, its upper full of flaws and air bubbles. The cakes are removed from the trough, broken up with sledge-hammers, and carried off to undergo the next process, that of puddling.

A puddling-furnace is of the reverberatory kind, and so constructed as to expose the almost fluid metal to a strong current of air. Here the requisite draught is obtained by a chimney and dampers. The metal is not in contact with the fuel, though exposed to its full heat. The metal here becomes viscid. The temperature is then lowered, the mass begins to bubble up, inflame, and give out a gaseous compound of carbon and oxygen. Its powers of cohesion become suspended, and it falls almost like powder. A vapour arises from it, the temperature is again raised, and the puddler, by the aid of a long bar, kneads up the metal into a ball of from 80 to 90 lbs. weight. This ball is then seized upon by the helper and dragged along the iron floor as a 'puddle-ball,' a glowing mass of impure iron, next to be subjected to the discipline of the hammer, weighing 4 to 5 tons. Tilted by the engine, and striking 100 to 120 blows per minute. Under this process the cinder, oxide, and other impurities connected with the iron, are violently jerked out, and the ball is beat into a dense angular bar or ingot, called a 'bloom.' In some works a 'pressure' is substituted for the hammer. The loss upon the processes of puddling, tilting, and the first rolling, is estimated at about 10 or 12 per cent.

With the hammer commences that division of the works called the *forge*, the more interesting because the processes are carried on under the eye of the spectator, and not, as before, in a close furnace. From the hammer the bloom is conveyed, still in a red-hot state, to

The rolling-mill, composed of two strong heavy parallel rollers of cast iron, cast with great care under a weight that ensures solidity, case-hardened, and turned truly cylindrical in a lathe. These, placed at a certain distance apart, are made by machinery to revolve each upon its own axis, but in opposite directions, so that their tendency, when in motion, is to draw in any body presented to them on the one side, and having compressed it, to force it out again upon the other. A rolling-mill is, in fact, a kind of press, and one mill differs from another in the size and strength of its 'rolls,' and in the pattern of certain grooves cut upon their circumference, by means of which the bar is reduced to the required figure.

The 'bloom' leaves the mill as a bar about 15 feet long, and three inches broad by one thick. This bar is immediately placed under a pair of shears, and cut up into short lengths, which being stacked upon a wheelbarrow are trundled off, still in a hot state, to the 'balling-furnace,' as 'puddle-bars,' or 'No. 1 bar iron.'

The balling-furnace is of the reverberatory order, and very much resembles that used in puddling. In it the metal is raised to a second heat preparatory to a second rolling. Five or six of the short 'puddle-bars' are piled flat upon each other upon a sort of long shovel. The 'baller' then slides them into the furnace as a baker his bread into the oven; and, finally, as each pile attains a cohering or welding heat, he withdraws it and passes it off

to the mill, where it is converted into a smooth, well-compressed bar, of the required dimensions. The bar is next carried to the circular saw to have the rough, or 'scollop' ends cut off, and then laid upon an iron floor to be straightened, which, in the case of railway bars, is a delicate process. The bar is then weighed, and having received from a punch the maker's mark, it is ready to pass into the market as 'No. 2 bar iron,' or 'merchant bars.' The loss upon this second heating and rolling is estimated at about 10 per cent.

No. 2 bar, though sufficiently good for general purposes, is yet capable of being improved in the prime qualities of strength and malleability, by a repetition of the processes of cutting up, heating, and rolling, as No. 3, or 'best bar,' this being the best quality of iron usually manufactured in South Wales. Cable-iron, nail and wire rod, boiler-plate, and iron for similar purposes, is thus repeatedly heated and drawn out. What is called 'scrap-iron' is composed of old nails, sauce-pans, and 'scrap,' and odds and ends of metal. It is for this reason that scrap iron is of the very best quality, and is much employed for axles and the more important parts of locomotive engines. Scrap iron is not manufactured in Wales.

From the manner in which the parts composing a bar of rolled iron have been arranged, its structure somewhat resembles that of the grain of wood, and a good smith, like a good joiner, will always work up his material with reference to this grain, or, in the phrase of the smithy, 'according to the way of the pile.'

The waste incurred during the several stages of the manufacture has already been stated. In round numbers, 100 parts of raw mine yield about 33 parts of pig iron, and 20 to 25 of best bar iron.

The quantity of water used in an iron-work is very considerable. Upon one occasion near Merthyr, a number of work-people were employed to ascend the furnace by ladders and to perform the office of the water, by descending in the balance bucket as a counterpoise to the ascending materials.

It has been said that the quantity of air forced into a blast furnace by the cold blast is about 88 tons in the twelve hours. Now, it is a well-known fact, that atmospheric air, below the temperature of 1,000 degrees Fahrenheit, does not support combustion.

It is said that an accident suggested to Mr. Neilson, the manager of the Clyde Works, the idea of obviating this inconvenience, by the injection into the furnace of a blast of air previously heated to a temperature as high as could economically be obtained.

In the Clyde Works, according to M. Dufresnoy's report, one ton of metal was reduced by the cold blast from 7 tons 17 cwt. of fuel, whereas the same fuel, under a blast heated to 612 degrees Fahrenheit, produced 2 tons 10 cwt. of metal, including the metal necessary to heat the air; or, in other words, gave a saving of nearly 70 per cent. upon fuel. The introduction of the hot blast was in fact the salvation of the Scotch iron trade, which it immediately raised from a most depressed to a flourishing condition.

The hot blast was first introduced into Wales at the Dowlais Works. But though successful in Scotland, it is said that recent experience has shown the saving upon the smelting of the Welsh ores to be much less considerable; and the hot blast has not been received into general use in Wales.

Recently, at the Ystafala works above Swansea, an attempt has been made by Mr. Budd to economise fuel, by conducting the heated air and gaseous products from the upper part of the blast-furnace to the steam-boilers of the blowing-engine, and so as to heat the air forming the blast. It appeared that upon one furnace, and with one boiler alone a saving was effected of 350l. per annum.

A THUMPER.—One solid block of Anglesea stone, weighing before dressing, twenty-seven tons, has just been placed in work as part of the coping of the arch over the western entrance of the tunnel, by the Bangor station of the Chester and Holyhead Railway. The arch is extremely massive, and must have cost an immensity of money.—*Welshman.*

RAILWAY JOTTINGS.

THE Railway Commissioners have begun to exercise their new power to extend the time for making railways. The *Gazette* of Tuesday week contains their formal certificate in favour of the Cornwall Railway and of the Delabole and York railways for an extension of time in carrying out their works. Railway companies are thus put in possession of a more expeditious and less expensive mode of proceeding than is involved in an application to Parliament. A large number have availed themselves of the relief. 125 applications have been received and considered; of these 121 have been entertained, and in most of the applications the extension of time asked for has been for the full additional term of two years allowed by the Act. The greater number include the whole of the railway and also of the lands to be taken. Four applications were refused on the ground that there were special provisions in the Act making the completion of the railway compulsory. The multitude of ever-recurring falsehoods, and contradictions of falsehoods, begotten by the want of confidence, alarm, and, it is to be hoped, groundless despondency in the world of railway news, almost prevents us from stating that among a number of similar reports it is said that 600 labourers have been discharged from that portion of the Manchester, Sheffield, and Lincolnshire line which is in course of construction near Sheffield. The extensive viaduct across the Wicker, however, is to be proceeded with; and operations are commenced for the re-erection of the 22 arches of the Rother viaduct, which recently fell. The works of the South Yorkshire line are said to be proceeding very rapidly and satisfactorily, especially in the neighbourhood of Conisbrough and Levitt Hagg. At the latter place, the work is heavy and tedious, the rock being to blast and cut to a depth of upwards of 70 ft. Near to Warmworth church, where this line crosses a valley parallel with the river Don, at a distance of nearly 100 yards, an embankment is raised 30 or 40 feet high. The weight of this material is so great, that the land has given way, and pressed the river bank two or three yards further into the water, somewhat obstructing the river traffic. "It is a pretty generally received opinion," says *Herepath*, "that no other property has been so much depreciated as railway property. If parties will take the trouble to look about them, they will find themselves mistaken. How is it the buildings which were going on so rapidly a couple of years ago are so generally stopped? Where ten houses were building in 1845, we will venture to say there is not more than one, if so many, now. Why is this? People perhaps may answer, it is because there are too many built, that the supply is greater than the demand. There may be something in that, for that particular kind of property; but that is not admitted by builders to be an answer. They say it is a reluctance to lend money, that money is not to be obtained, and that when they have built houses they can find no purchasers. A similar observation we heard an eminent solicitor make the other day. If they apply to their clients to lend money on the best of freehold security on mortgage, it is not to be had. They shrug their shoulders and say, 'Under the present state of things we cannot venture to lend our money. We must have it where we can get it back at a very short notice, though it be at a less rate of interest.' That is the cry everywhere. It is an utter prostration of confidence which is afflicting the world. It is not a want of money, for perhaps it has rarely been in so great an abundance, but a want of confidence from day to day in the stability of our affairs." Have we not here something very like a secular phase of that desolate and universal want of faith predicted in the holy book of books, while waiting over all the agonies of travail through which the world, affrighted more than hurt, must enter on that new and glorious birth of power and goodness faith and truth, predicted by the apostles and their Lord and master?

COMPETITION.—Architects have been called upon to compete for the construction of a new training school for schoolmasters at Chichester, at a cost not exceeding 3,500l. Plans and specifications to be lodged before 7th Dec. next.